Turning temperature measures outside-in

Most studies of the health effects of temperature and humidity use networks of outdoor weather stations, but as most people spend most of their time inside we should also be using indoor temperature. Indoor temperature and humidity monitors are available for a reasonable cost. A network of indoor monitors could be placed in volunteer homes across a city to give a representative estimate of exposure. The network would send hourly data to a central site. This data would be of great value for cold- and heat-warning systems and would potentially be a more accurate exposure for epidemiological studies.

Ambient temperature is a risk factor for cardiovascular disease with both high and low temperatures increasing risk.[1] Epidemiological studies almost exclusively used outdoor temperature from a network of weather stations. From a health perspective these stations are often in the most unhelpful locations. For example, in Brisbane two well-established stations are at the international airport and in a national park in the bay.

Indoor temperature and humidity could give a more accurate estimate of risk, either alone or in combination with outdoor measures. Indoor monitors could be placed in volunteers' homes across a city and programmed to send hourly readings to a central data collection site. Volunteer homes could be selected to give a good geographical spread and to give a representative picture of local housing types. This could be achieved by using a sampling frame of houses from local government data and then creating a stratified random sample. Recruitment could be eased by offering an annual payment in return for usable data. The volunteers would be a sentinel population whose indoor environments would hopefully be representative of the wider population. Alternatively volunteers could be restricted to high risk groups such as the elderly.

Indoor data would be of great value for the common epidemiological time series studies that compare daily morbidity or mortality numbers with daily temperatures.[2] An indoor temperature estimate with less measurement error would likely strengthen the established risks of cold and hot temperatures.

Indoor temperature should be a more sensitive measure for cold- and heat-warning systems,[3] possibly providing warnings that are more timely and more accurate, especially during disruptions such as power cuts.

The number of monitors needed would depend on the variability in indoor temperature and the desired accuracy. If the standard deviation of indoor temperature was 4 °C (based on Bøkenes et al[4]) and we wanted to estimate the mean indoor temperature with a margin of error of ±0.5 °C using a 95% confidence interval then we would need around 250 monitors. A wider a margin of error of ±1 °C would only need 64 monitors.

Given the wide variability in people's activity, an indoor network is unlikely to be useful for all populations. It may also not add value in cities where indoor temperatures are generally well controlled, and it would also have less value during low risk periods in spring and fall.

Previous examinations of the many available combinations of outdoor temperature and humidity (including apparent temperature, the Humidex, maximum temperature and minimum temperature) have failed to find a universal measure that best predicts risk in all locations.[5] Even in the same city the best measure often changes from year to year.[6] This failure could be due to measurement error because of the use of outdoor temperature as a proxy for the potentially more important exposure of indoor temperature. The last iota of variance has been wrung from outdoor temperature and humidity. If we want better predictions of health and timely public health warnings then we need to move behind closed doors.

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